

ENERGY STAR® Program Requirements for Set-top Boxes

Eligibility Criteria

Below is the product specification for ENERGY STAR qualified set-top boxes. A product must meet all of the identified criteria if it is to be labeled as ENERGY STAR by its manufacturer.

- 1) Definitions: Below is a brief description of a set-top box and its common operational modes as relevant to ENERGY STAR. The ENERGY STAR specification focuses on reducing energy consumption while the product is in the Standby/Low-power Mode.
 - A. Set-top Box: A commercially available electronic product encased in a single housing whose purpose is to receive, send, process, translate, and/or record signals that are then sent to a television or similar display device for viewing or to a computer for processing. Products currently covered under the TV/VCR and Home Audio/DVD specifications are not eligible to qualify for the ENERGY STAR label under Set-top Boxes. As the TV/VCR and Home Audio/DVD specifications are revised, EPA will make a concerted effort to coordinate and/or consolidate, as appropriate, the energy-efficiency specifications across TV/VCRs, Home Audio/DVDs, and Set-top Boxes.
 - B. Standby/Low-power Mode: A low-power state that the set-top box product model enters while connected to a power source. In this mode, the product usually appears to be “OFF” to the user, but may be capable of responding to a signal (e.g., a signal sent from a head end or data provider) and may continue to perform some functions (e.g., remote control sensing, time readout, and hard drive spinning).
 - C. Active Mode: The mode in which the product has been turned “ON” by the user. The product is connected to a power source and is receiving, sending, processing, translating, and/or recording signals. The power requirement in this mode is typically greater than the power requirement in Standby/Low-power Mode.
 - D. Disconnect: The mode in which the product is disconnected from all external power sources.
- 2) Qualifying Products: For the purposes of ENERGY STAR, set-top box products include the following: analog cable TV set-top boxes, advanced analog cable TV set-top boxes, digital TV converter set-top boxes, Internet access devices, video game consoles, videophone set-top boxes, set-top boxes with cable modems, digital cable TV set-top boxes, satellite TV set-top boxes, wireless TV set-top boxes (e.g., MMDS and LMDS), personal video recorders (e.g., TiVo and Replay TV), and multifunction devices. For the purposes of ENERGY STAR, a multifunction device is defined as a physically integrated device that has the core function of a satellite TV set-top box, digital cable TV set-top box, wireless TV set-top box, or personal video recorder plus one or more additional functionalities, such as an Internet access device or video game console.
- 3) Energy-Efficiency Specifications for Qualifying Products: Only those products listed in Section 2 that meet the criteria below (see items A through C and Table 1) may qualify as ENERGY STAR. For convenience, EPA has developed its specification based on Standby/Low-power Mode. However, if a product model meets all of the criteria below in Active Mode, it may qualify for the label.
 - A. If the product is designed for a network environment, then it must retain network connectivity (e.g., communication with a head end or service provider) and the ability to be awakened by a remote

source in the Standby/Low-power Mode.

- B. Products with a hard off “standby” mode may qualify for the ENERGY STAR label. If a particular model has multiple standby/low-power modes and one of them is a hard-off “standby” mode, the power measurement must be taken with the unit in the most energy consumptive standby/low-power mode.
- C. The manufacturer must ensure that the energy-saving features or design of the ENERGY STAR qualified product do not interfere with or adversely impact the performance of the product.
- D. The average power needs during the Standby/Low-power Mode must not exceed the values in Table 1 below.

Table 1: Energy-Efficiency Criteria for ENERGY STAR Qualified Set-top Boxes

Product Category	Tier 1: Standby/Low-power Mode	Tier 2: Standby/Low-power Mode
Category 1 <ul style="list-style-type: none"> Analog Cable TV Set-top Box Advanced Analog Cable TV Set-top Box Digital TV Converter Set-top Box Internet Access Device Video Game Console Videophone Set-top Box Set-top Box (e.g., Internet access device) with Cable Modem for enhanced communications in Standby/Low-power Mode 	≤ 3 Watts	One specification for all set-top boxes: ≤ 7 Watts (for satellite systems, add ≤ 5 Watts for each LNB)
Category 2 <ul style="list-style-type: none"> Digital Cable TV Set-top Box Satellite TV Set-top Box* Wireless TV Set-top Box Personal Video Recorder 	≤ 15 Watts (for satellite systems, add ≤ 5 Watts for each LNB)	
Category 3 <ul style="list-style-type: none"> Multifunction Device (i.e., a physically integrated device that has the core function of a satellite TV set-top box, digital cable TV set-top box, wireless TV set-top box, or personal video recorder plus one or more additional functionalities, such as an Internet access device or video game console) 	≤ 20 Watts (for satellite systems, add ≤ 5 Watts for each LNB)	

*NOTE: The ENERGY STAR Tier 1 specification for each stand-alone satellite receiver is 15 Watts or less; manufacturers may add an additional 5 Watts or less to the specification for each LNB sold with a receiver. For example, a model sold with one receiver and a single LNB must consume 20 Watts or less to qualify for the ENERGY STAR label. Similarly, a model sold with one receiver and a dual LNB must consume 25 Watts or less, and a model with two receivers and a dual LNB must consume 40 Watts or less. Please note that LNBs sold separately may *not* qualify for the label.

- 4) **Power Measurement:** Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. The power requirement shall be measured from the outlet or power supply source to the product under test. The product manufacturer (i.e., ENERGY STAR Partner) shall measure the average true power (in Watts) of the product. When performing measurements to self-certify a product model, the products under test must be in the condition (e.g., configuration and settings) shipped to the customer. In addition, if a product is designed for a network environment, it must be tested while connected to the network to ensure that all power consumption and performance criteria are met.

- 5) **Test Criteria:** This protocol should be followed to ensure consistency in measuring the power requirements for ENERGY STAR qualified set-top boxes. Outlined in Section A are the ambient test conditions that should be respected when performing power measurements. These conditions ensure that outside factors do not affect the test results and that the test results can be reproduced. Sections B and C describe the specifications for testing equipment and the test method, respectively. Section D reviews responsibilities, while Section E covers continuing verification.

A. **Test Conditions**

General Criteria:

Total Harmonic Distortion (Voltage):	< 3% THD
Ambient Temperature:	22°C ± 4°C

Terminations: External speaker terminals terminated per 3.6.2.2 (IEC 107-1)

Market-Specific Criteria:

Market:	United States	Europe and Australia	Japan
Voltage:	115 V RMS ± 3 V RMS	230 V RMS ± 10 V RMS	100 V RMS ± 5 V RMS & 200 V RMS ± 10 V RMS
Frequency:	60 Hz ± 3 Hz	50 Hz ± 3 Hz	50 Hz ± 3 Hz & 60 Hz ± 3 Hz

Note: Testing needs to be done only at a voltage and frequency in the above range. It is not necessary to test all combinations of high voltage/low frequency, high voltage/high frequency, etc.

- B. **Test Equipment:** Manufacturers should measure and report the true standby/low-power mode¹ requirements of the product. Doing so necessitates the use of a true power watt meter. Because there are many watt meters from which to choose, manufacturers need to exercise care in selecting an appropriate model. The following items should be considered when procuring equipment and performing the test:
1. AC Power Source (with sufficient output current for the test unit such that it meets the requirement for AC line voltage, frequency stability, and THD).
 2. True Power Meter (with sufficient accuracy, resolution, crest factor rating, and bandwidth).
 3. Oscilloscope with Current Probe (to monitor AC line current waveform, amplitude, and frequency. Optional but recommended).
 4. True RMS Volt Meter (to verify voltage at the input of test unit. Optional if AC source output is sufficiently accurate).
 5. Frequency Counter (to verify frequency at the input of test unit. Optional if AC source output is sufficiently accurate).

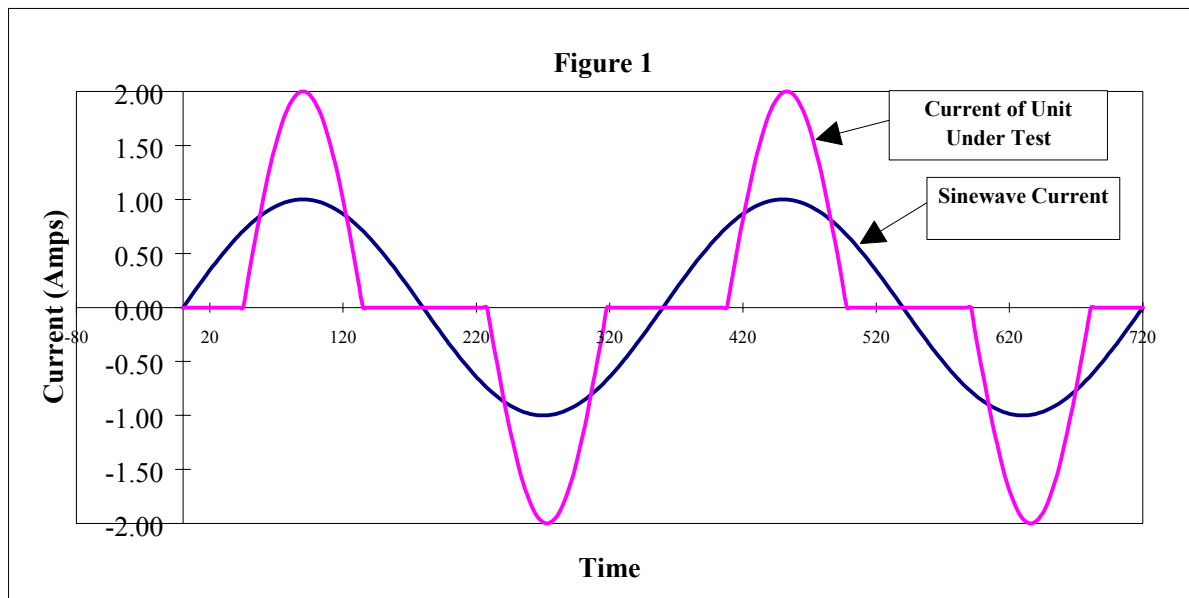
¹ True power is defined as (volts)x(amps)x(power factor) and is typically reported as watts. Apparent power is defined as (volts)x(amps) and is usually expressed in terms of VA or volt-amps. The power factor for equipment with switching power supplies is always less than 1.0; therefore, true power is always less than apparent power.

Crest Factor: Electronics equipment may draw current that is not sinusoidal.² While virtually any watt meter can measure a standard current waveform, it is more difficult to select a watt meter when irregular current waveforms are involved.

It is critical that the watt meter selected be capable of reading the current drawn by the product without causing internal peak distortion (i.e., clipping off the top of the current wave). This requires a review of the meter's crest factor rating and the current ranges available on the meter. Better quality meters will have higher crest factor specifications and more choices of current ranges.

To determine the crest factor rating requirement of the meter and the proper current range settings, the peak current (amps) draw of the product under test in standby/low-power mode must first be measured. This can be accomplished using an oscilloscope with a current probe.

A current range on the meter must be selected that is sufficient to register the peak current. Specifically, the full-scale value of the selected current range multiplied by the crest factor of the meter (for current) must be at least 15% greater than the peak current reading from the oscilloscope to compensate for any measurement error. (Note: It is difficult to measure within 5% using an analog oscilloscope.) For example, if a watt meter has a crest factor of 4 and the current range is set on 3 amps, the meter can register current spikes of up to 12 amps. If measured peak current is only 6 amps, the meter would be satisfactory. If, however, the current range is set too high, the meter may lose accuracy in measuring non-peak current. Therefore, some delicate balancing is necessary. When choosing a meter, make sure that the crest factor is given for the current level that you desire.



² The crest factor of a current waveform is defined as the ratio of the peak current (amps) to the RMS current (amps). The crest factor for a sinusoidal 60 Hz current waveform is always 1.4. The crest factor for a current waveform associated with a product containing a switching power supply will always be greater than 1.4 (though typically no higher than 8).

Frequency Response: Another issue to consider when selecting a watt meter is the frequency response rating of the meter. Electronics equipment may cause harmonic waveforms that can lead to inaccuracies in the power measurements. For example, electronics equipment powered by switching power supplies typically produces odd harmonics up to the 21st. To ensure that the harmonics are properly addressed, ENERGY STAR recommends the use of a watt meter with frequency response of at least 3 kHz. This will account for harmonics up to the 50th, which is recommended by IEC 555.

Resolution: Manufacturers should choose a watt meter that can provide resolution of 0.1 watt.

Accuracy: Catalogues and specification sheets for watt meters typically provide information on the accuracy of power readings that can be achieved at different range settings. If the power measurement is very close to the energy-efficiency guideline specified in these Program Requirements (Eligibility Criteria), a test procedure with greater accuracy will be necessary. For example, if the ENERGY STAR specification is 1.0 watt or less *and* the resulting accuracy of the watt meter at the test settings is ± 0.1 watts, then a power measurement of less than 0.9 watts will ensure that the product is compliant.

Calibration: To maintain their accuracy, watt meters should be calibrated every year with a standard that is traceable to the U.S. National Bureau of Standards (NBS).

C. **Test Method:** Following are the test steps for measuring the true power requirements of the test unit in standby/low-power mode:

1. Power on all test equipment and properly adjust operation range.
2. Connect the test equipment and unit under test.
3. Check for normal operation of the test unit and leave all customer adjustment to factory default settings (i.e., unit must be in the condition shipped to the customer). In addition, if a product is designed for a network environment, it must be tested while connected to the network to ensure that all power consumption and performance criteria are met.
4. Bring the test unit into standby/low-power mode (not disconnect mode) either by using the remote control device or by using the ON/OFF switch on the test unit cabinet.
5. Either verify that the wall outlet power is within specifications or adjust the AC power source output as described in Section A (e.g., 115Vrms \pm 3Vrms, 60Hz \pm 3Hz).
6. Set the power meter current range. The selected full scale value multiplied by the crest factor rating ($I_{\text{peak}}/I_{\text{rms}}$) of the meter must be greater than the peak current reading from the oscilloscope.
7. After the unit under test reaches operating temperature and the readings on the power meter stabilize (approximately 90 minutes), take the true power reading in watts from the power meter.
8. Record the test conditions and test data. The measurement time shall be sufficiently long to measure the correct average* value to within a +10% - 0% error. If the device has different standby/low-power modes that can be manually selected, the measurement should be taken with the device in the most power consumptive mode. If the modes are cycled through automatically, the measurement time should be long enough to obtain a true average that includes all modes.

*** The power consumption measurement will be continued for 24 hours and averaged or until the time period where averaged power consumption can be accurately measured. The**

time period for testing an individual model is based upon its standby/low-power mode consumption profile.

Example 1: A unit under test [UUT] has modes that every 10 minutes put it into a low-power state for 9 minutes and a higher power state for 1 minute. An average over 10 minutes will be sufficient to capture the true average power consumption of the device.

Example 2: The UUT has complex modes that put it in a low-power state for 4 hours and an alternating high-low power state for 1 hour. An average over 5 hours will be sufficient to capture the true average power consumption of the device.

- D. Responsibilities: ENERGY STAR's test criteria are not mandatory, but they will be distributed to outside parties such as buyers and the press. Following the test criteria and producing accurate test results will assist manufacturers in qualifying and labeling products as ENERGY STAR. Companies may determine the appropriate level of stringency and accuracy for their own testing based on their specific products.
 - E. Continuing Verification: This testing procedure (protocol) describes the method by which a single unit may be tested and qualify as an ENERGY STAR labeled product. An ongoing testing process is highly recommended to ensure that products from different production runs qualify for ENERGY STAR. A model may qualify as ENERGY STAR if testing indicates that 95 percent of the units sold under this model name/number will meet the specifications contained in these Program Requirements (Eligibility Criteria).
- 6) Effective Date: The date that manufacturers may begin to qualify products as ENERGY STAR will be defined as the *effective date* of the agreement.
- A. Tier 1 - The first phase of this specification, Tier 1, shall commence on January 1, 2001 and conclude on December 31, 2003. Upon signing the agreement, the Partner may begin to use the ENERGY STAR logo on product models, packaging, or other product-related materials that meet the Tier 1 specification. (Refer to the ENERGY STAR Logo Use Guidelines for more information.) Marketing and promotional activities in support of ENERGY STAR labeled set-top boxes (e.g., product launch) will be conducted by EPA, with assistance from partners and the Electronics Industry Alliance/Consumer Electronics Association (EIA/CEA), at the 2001 Consumer Electronics Show (CES®)
 - B. Tier 2 - The second phase of this specification, Tier 2, shall commence on January 1, 2004. The specification for Tier 2 shall apply to products that the Partner begins to ship after December 31, 2003. However, once an individual product model is qualified by the Partner as ENERGY STAR, the model, packaging, or other product-related materials may continue to bear the ENERGY STAR logo until the model is phased out of the market (i.e., the Tier 2 specification will not apply retroactively to models previously qualified under the Tier 1 specification).
- 7) Future Specification Revisions: ENERGY STAR reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. EPA believes that new technologies are already available to further reduce Standby/Low-power Mode power requirements in set-top boxes and that future levels will be consistent with those levels recently negotiated for other home electronics.